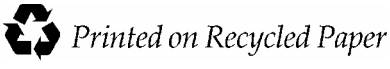
Little Klickitat River Watershed Temperature TMDL

Draft
Detailed Implementation Plan

November 2004
Publication Number 04-10-075



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Draft
Detailed Implementation Plan

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Water Quality Program

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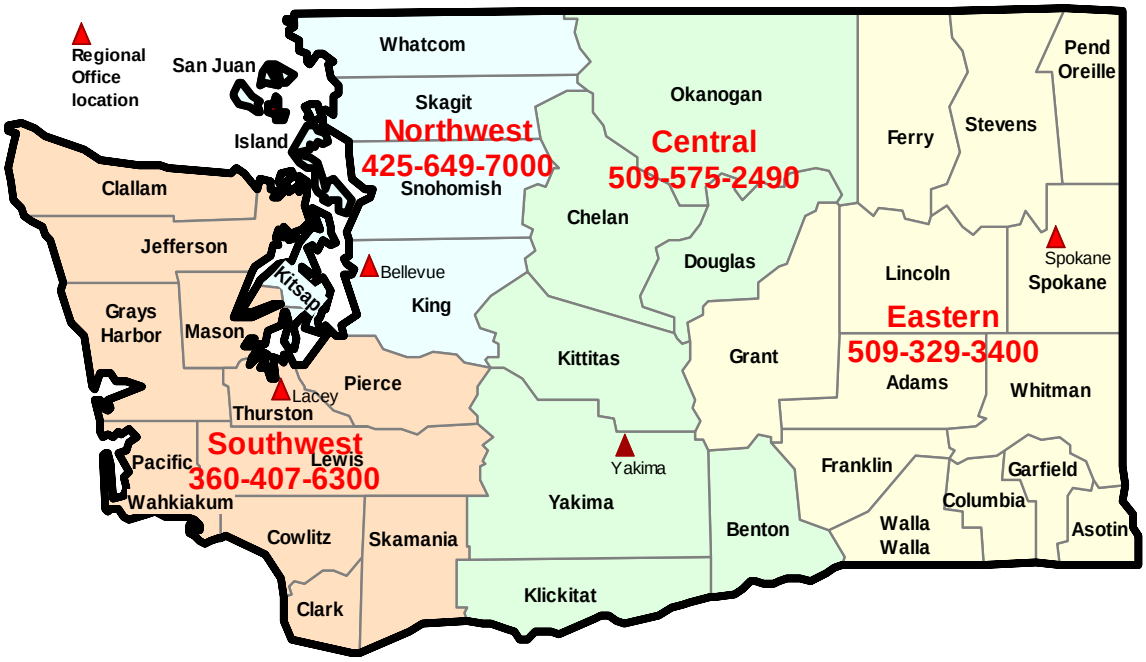

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Abstract

The Little Klickitat River watershed encompasses approximately 285 square miles in south-central Washington State. The Little Klickitat River and its tributaries – East Prong, West Prong, and Butler Creek – are listed on the 1996 and 1998 Washington State 303(d) lists for elevated water temperatures. Fieldwork by Ecology, the Central Klickitat Conservation District, and Yakama Nation Fisheries provided data to further describe temperature conditions throughout the watershed.

Effective shade is used as a surrogate measure of heat flux to fulfill the requirements of the Clean Water Act's Section 303(d) for a Total Maximum Daily Load (TMDL) for temperature. Effective shade is defined as the fraction of incoming solar shortwave radiation above the vegetation and topography that is blocked from reaching the surface of the stream. The load allocations for this TMDL can be met through a series of land and water management practices presented in this Detailed Implementation Plan (DIP).

Progress towards goals will be measured by monitoring the rate of implementation of activities presented in this DIP, and by monitoring stream temperatures in the watershed.

Introduction

In 1999, the Washington State Department of Ecology (Ecology) began an assessment of the 1996 and 1998 303(d) listings for stream temperature in the Little Klickitat River Watershed. The segments listed can be viewed on the map in Figure 2 or Table 1. The purpose of the investigation was to determine the conditions causing heat loading to surface waters in the Little Klickitat River Watershed during the warmest weeks of the year (called the critical period). To do this, Ecology used models and other information to calculate potential effective shade that could be provided by vegetation improvements and existing topography. Then, modeling predicted what effects on stream temperature achieving such potential effective shade conditions would result. Additionally, the study provided data that showed there were stream segments that did not meet temperature standards, though they were not listed on the 1996 or 1998 303(d) list. These segments are listed in Table 2. This Detailed Implementation Plan provides direction to restore stream temperatures throughout the Little Klickitat River Watershed.

The results of the investigation were published in a technical report titled "Little Klickitat River Watershed Temperature TMDL" (Brock and Stohr). The technical report detailed conditions in the watershed that affect stream temperature. Ecology compared existing stream conditions to state standards and predicted stream temperatures under improved conditions created by the restoration of riparian area vegetation. Existing vegetation and topography accounted for existing effective shade levels used in the study. Effective shade levels were measured between 17.8 and 77.5 percent throughout the watershed. The technical report predicts that effective shade levels can improve to measure within a range of 50 to 95 percent. In some areas of the watershed, water temperature has the potential to improve as much as 8 to 10 degrees Celsius during the warmest weeks of the year (as much as 18 degrees F).

The study measured various environmental elements that affect water temperature, and demonstrated that low stream shading was the primary anthropogenic factor affecting stream temperature. The study noted that sediment deposition, channel widening, low flows and near stream disturbance zone (NSDZ) widening are also causes of increased stream temperatures in the Little Klickitat Watershed. Figures 1 and 3 show the processes that can affect stream temperature.

After the technical report was completed, Ecology provided the Environmental Protection Agency (EPA) with a TMDL submittal report titled "Little Klickitat River Watershed Temperature Total Maximum Daily Load, Submittal Report" (the submittal report). The submittal report was turned in to EPA in May of 2003 and accepted in June of 2003. The submittal report contained a Summary Implementation Strategy, which predicted and presented generalities for implementing the TMDL. This Detailed Implementation Plan (DIP) expands on the original TMDL study for temperature in the Little Klickitat River Watershed, and provides recommendations for stream temperature improvements, reference and resources as well as a monitoring strategy for evaluating effectiveness of implementation activities in the Little Klickitat River Watershed.

Table 1: 1998 303(d) Listings for Temperature in the Little Klickitat River Watershed

Name	T	R	S	Parameter	Medium	Action	96 List	98 List
Butler Creek	*05N*	*17E*	*17*	*Temp*	*Water*	*TMDL*	*yes*	*yes*
East Prong	*06N*	*17E*	*35*	*Temp*	*Water*	*TMDL*	*yes*	*yes*
East Prong	*05N*	*17E*	*10*	*Temp*	*Water*	*TMDL*	*yes*	*yes*
East Prong	*05N*	*17E*	*03*	*Temp*	*Water*	*TMDL*	*yes*	*yes*
East Prong	*05N*	*17E*	*09*	*Temp*	*Water*	*TMDL*	*yes*	*yes*
East Prong	*05N*	*17E*	*16*	*Temp*	*Water*	*TMDL*	*yes*	*yes*
Little Klickitat River	*04N*	*14E*	*09*	*Temp*	*Water*	*TMDL*	*yes*	*yes*
West Prong	*05N*	*17E*	*18*	*Temp*	*Water*	*TMDL*	*yes*	*yes*

Table 2: Stream segments identified as impaired, but not 303(d) listed for temperature.

Name	T	R	S	New Water Body **ID Number**	Old Water Body **ID Number**	Parameter
Blockhouse Creek	*04N*	*15E*	*17*	*ID95ML*	*WA-30-1023*	*Temperature*
Bowman Creek	*05N*	*14E*	*35*	*TN94DB*	*WA-30-1023*	*Temperature*
Little Klickitat River	*04N*	*15E*	*28*	*AY21LB*	*WA-30-1020*	*Temperature*
Mill Creek	*04N*	*15E*	*05*	*FF43IZ*	*WA-30-1022*	*Temperature*

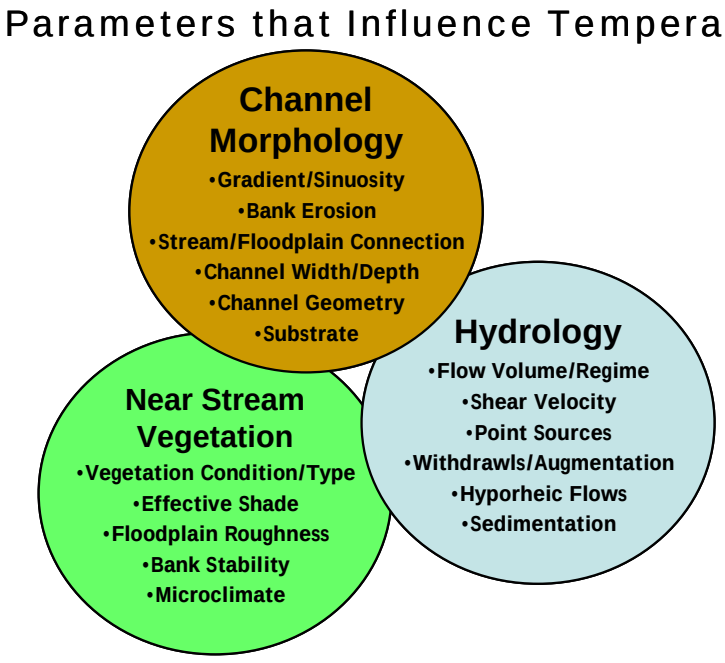

Figure 1: Processes that affect stream temperature

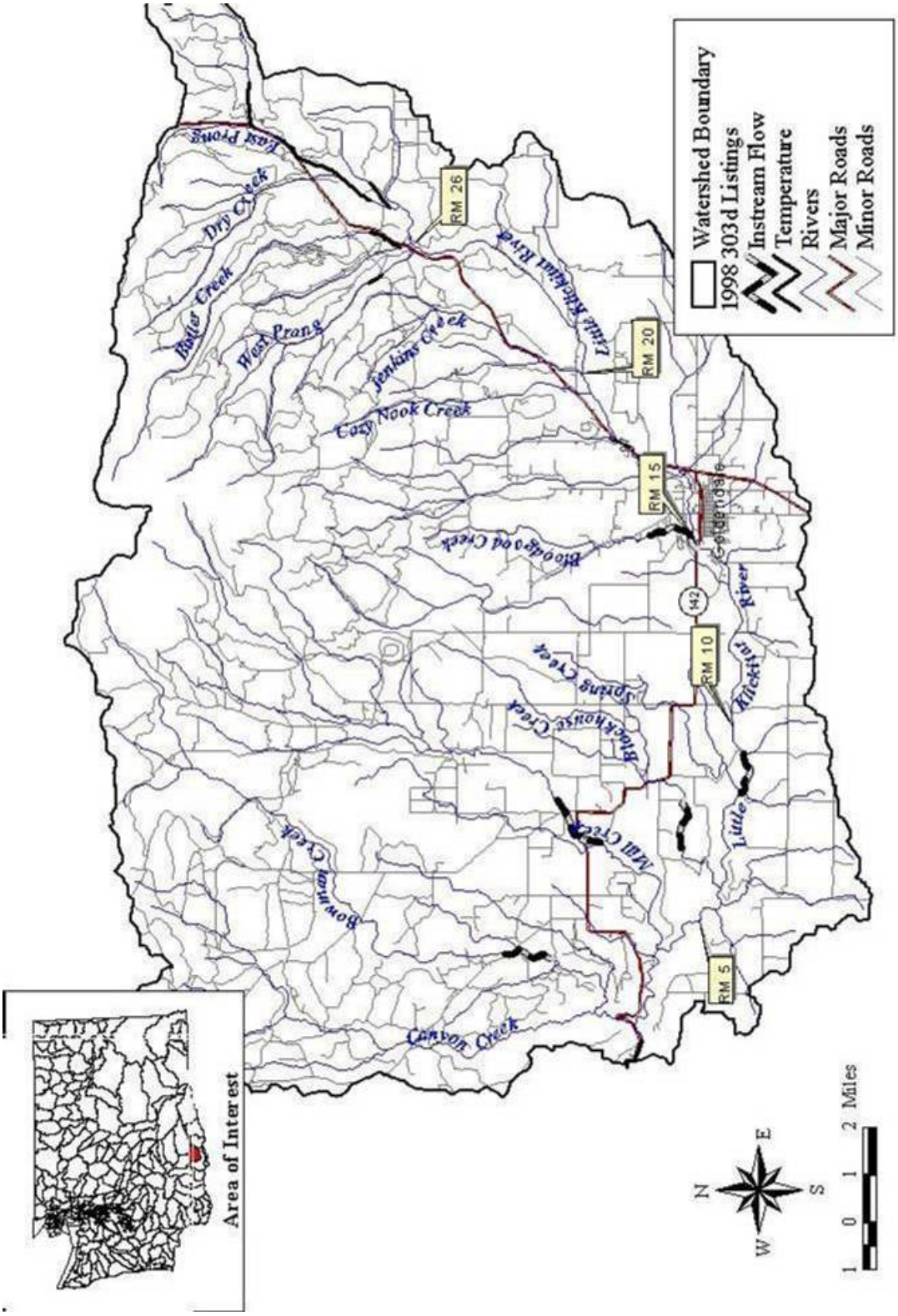

Figure 2: Map of Little Klickitat Watershed showing 303(d) listed stream segments

Approach

The Clean Water Act mandates the Washington State Department of Ecology to develop Total Maximum Daily Load (TMDL) studies for water bodies that fail to meet water quality standards after technology based water quality controls have been put into place. In 1997, Ecology signed a Memorandum of Agreement with the Environmental Protection Agency (EPA) assuring that TMDLs would be developed for all water bodies on the 1996 303(d) list. Additionally, Ecology agreed to develop Detailed Implementation Plans (DIPs) to direct the implementation of these TMDLs.

Many existing regulations, agreements, and planning processes potentially affect stream improvements in the Columbia River Watershed, the State of Washington, Klickitat County, and the Little Klickitat River Watershed. Actions taken pursuant to this TMDL DIP fall into three categories: voluntary stewardship actions; actions taken in accordance with a law, legal agreement, or existing planning process; and monitoring activities. Stewardship activities will be completed as quickly as possible. Education of the benefits of land and water stewardship, coupled with the availability of cost share money usually accelerates the rate of voluntary stewardship activity. Actions that are taken in accordance with an existing planning process, law or legal agreement, if applicable, will be completed within the time frame prescribed by the planning document, law or legal agreement. Complex monitoring programs are not necessary every year, but it is important to document hydrologic, morphologic and vegetative changes in the watershed to some degree on a yearly basis.

There are other planning processes in Klickitat County that may prescribe similar stream habitat enhancement and protection measures similar to this plan. These plans are broader in scope than the Little Klickitat River Watershed, but projects implemented under these plans may help temperatures in the Little Klickitat River Watershed.

The Little Klickitat River Watershed Temperature TMDL and this DIP are not new regulations, but a description of actions that cause water temperature problems and a list of practices that can protect and enhance water temperatures in the Little Klickitat River Watershed. These actions are voluntary related to this TMDL, but they may be required by federal, state, county or city laws. The exclusion of livestock from vegetated stream banks, for example, is a voluntary stewardship action prescribed by this plan, but the degradation of water quality, whether by livestock grazing or any other action is not allowed according to state (Washington State Water Pollution Control Act RCW 90.48) and federal laws (Clean Water Act).

This plan pairs general examples of land use practices and best management practices (BMPs) with general land and waterway problems documented in the TMDL. This plan does not provide enough details to serve as technical guidance for individual restoration projects, but is a guide for general restoration activities and monitoring activities related to stream temperature improvements in the watershed. For specific land and stream restoration assistance Ecology recommends that land owners and managers consult with professional staff from the Central Klickitat Conservation District, the Natural Resource Conservation Service or other qualified natural resource professionals.

This plan presents a long term monitoring strategy. Given the long period of time that it takes for vegetation to establish and mature, the monitoring will not only focus on changes in water temperature, but changes in land use techniques that can affect the long term health of the watershed as it relates to water temperature. In addition, monitoring is a critical component of this DIP's adaptive management strategy. The collection and analysis of information related to the health of the Little Klickitat River Watershed can be used by local land managers and planners to direct activities in a manner protective and restorative of water quality. Stream temperature improvements often necessitate a holistic look at the entire watershed. Many of the Little Klickitat River's characteristics that affect stream temperature can be affected by land and water use activities in the watershed. For example, wells pumping out of sources connected to the hyporheic zone, de-vegetating uplands, and compaction of soils can all affect the amount of and timing of flows in the river and tributaries. Many activities can have an effect on the amount of shade available to protect water temperature and the amount of and timing of sediment entering the river. Plant species native to the riparian zone in the Little Klickitat River Watershed are adapted to the natural hydrologic cycle of the area. An annual hydrograph that mimics the hydrograph prior to land manipulation would most likely induce the quickest, most effective restoration of the riparian zone.

Pollution Sources and Organizational Responsibilities

Point Source Pollution Sources:

The only point source pollution discharger in the Little Klickitat River Watershed identified by the technical report and submittal report that may affect stream temperature is the City of Goldendale's Waste Water Treatment Plant.

The Wastewater Treatment Plant has been given the full Waste Load Allocation (WLA) available. In other words, because there are no other NPDES permitted point sources to the Little Klickitat River; the WLA is not divided for different sources. Incidentally, because the treatment plant is an existing source, they have a 10-year compliance schedule to meet the WLA.

The WLA for the WWTP was set under modeled conditions as recommended by EPA staff reviewing the technical report. Under current conditions during the critical period the WWTP may or may not be violating narrative state water quality standards. However, during non-critical times of the year, when more and cooler water is flowing in the Little Klickitat River the treatment plant may or may not be within state standards.

Below is the table from the submittal report detailing the Waste Load Allocation for the Goldendale Wastewater Treatment Plant.

Table 3: Waste Load Allocation for Goldendale Wastewater Treatment Plant

Facility Name, City	Receiving Water Body, RM	7Q10 Low Flow (cfs)	Facility Design Flow	System Potential Temperature	Waste Load Allocation		
					Current Effluent Temperature	Allowable Temperature Change at Edge of Mixing Zone	Allowable Effluent Temperature (oC)
Goldendale WWTP	Little Klickitat, RM 14.0	4.48	0.774	Dependent on conditions	n/a	0.3	18.3

Nonpoint Sources of Pollution

Effective Shade:

The Little Klickitat River Watershed Temperature TMDL concluded that the primary cause of elevated water temperatures in the Little Klickitat River Watershed is lower than potential levels of riparian shade. Ecology used effective shade because it is the EPA recognized surrogate for heat loading. Effective shade is used as a surrogate measure of heat flux (heating of the river caused by solar radiation) to fulfill the requirements of Section 303(d) for a Total Maximum Daily Load (TMDL). Effective shade is defined as the fraction of incoming solar short wave radiation above the topography and vegetation that is blocked from reaching the surface of the stream. In other words, topography and vegetation that blocks sunlight from reaching the stream creates shade, the percentage of sunlight that these components effectively prevent from reaching the stream surface is called percent effective shade.

Vegetation is sparse throughout the Little Klickitat River Watershed for various reasons. Naturally, watersheds with dry climates have relatively sparse vegetation compared to watersheds with wetter climates; however, given their moist condition, riparian zones can support an abundance of vegetation compared to drier uplands. Disturbances such as grazing, logging and road building have affected the amount and type of riparian vegetation in the Little Klickitat River (Brock and Stohr). Additionally, hydrology and stream geomorphology can have an impact on stream restoration. If water is taken out of the stream to irrigate crops, then the riparian zone along the stream below the diversion might dry out, and thus give way to dry land vegetation, rather than riparian zone vegetation. The following is from the abstract of Morris (1995):

> *Stream restoration is fundamentally a geomorphic activity, inasmuch as quasi-equilibrium stream channels and functional floodplains promote the greatest aquatic and terrestrial habitat diversity and represent the natural conditions under which riparian ecosystems develop.*

The TMDL technical study evaluated sights along the Little Klickitat River using data collected in the field, data obtained from aerial photos, information from Central Klickitat Conservation District staff and Geographic Information Systems to predict available effective shade and potential effective shade.

The load allocations for effective shade from the technical report and the submittal report are presented below.

Load allocations for effective shade for Butler Creek, East Prong, and West Prong are presented in Table 4. The Load Allocations for effective shade along the Little Klickitat River are presented in Table 5. The load allocations represent model calculated values for site potential shade. So, the load allocations are based on improving shade conditions to their potential value along streams in the watershed. In general, the load allocations for effective shade are as follows:

- For the entire Little Klickitat watershed, including Butler Creek, East Prong, and West Prong, 95 to 50% effective shade produced by a mature riparian corridor and existing topography is the load allocation for shade from riparian vegetation.
- For portions of the Little Klickitat River and West Prong, additional temperature reduction may be possible through the reduction of the wetted width-to-depth (W/D) ratio.
- For all perennial streams in the Little Klickitat River watershed that were not specifically modeled, including Bowman, Mill, Spring, and Blockhouse creeks, and that exceeded the water quality standard during critical and median conditions (Figures 6 and 7), 73% effective shade produced by mature riparian vegetation is the LA . An effective shade of 73% is the average load allocation for all modeled segments on the Little Klickitat River, West Prong, and Butler Creek.
- Additionally, Bloodgood Creek, which does not exceed numeric water quality standards, provides the only source of cooling water to the Little Klickitat River. Efforts should be made to protect this cool source of water.

Table 4: Loading Capacity and Load Allocations for Butler Creek, East Prong, West Prong and all un-modeled tributaries in the watershed.

Tributary	Current Effective Shade (%)	Current Solar Load (%)	Load Allocation		
			Target Solar Load (%)	Required Solar Reduction (%)	Target Effective Shade(%)
Butler	55.0	284	111	44	95
East Prong	62.3	224	33	75	94
West Prong	77.5	36	12	50	93
Spring Creek	38.6				73
Blockhouse	68.1				73
Mill Creek	59.2				73
Bowman Creek	50.7				73
Un modeled Tributaries					73

Table 5: Load capacity and load allocation for the Little Klickitat River

Station Name	Distance downstream from headwater (km)	Current Effective Shade (%)	Current Solar Load (ly/day)	Load Allocation		
				Target Solar Load (ly/dy)	Required Solar % Reduction	Target Effective Shade (%)
3 Creeks	1.0	58.7%	10274	5397	31	78
	2.0	54.4%				79
	3.0	59.4%				79
	4.0	34.9%				76
	5.0	50.0%				74
	6.0	43.7%				81
	7.0	47.4%				80
	8.1	33.5%				79
	9.1	17.8%				83
	10.1	37.2%				82
	11.1	55.1%				83
	12.1	51.5%				83
	13.1	57.4%				79
Rimrock	14.1	60.0%	14413	5746	43	81
	15.1	42.1%				77
	16.1	60.2%				82
	17.1	66.6%				86
	18.1	66.7%				86
Tom Miller	19.1	46.4%	20203	5065	60%	82
	20.1	18.9%				76
	21.1	24.8%				78
	22.1	29.4%				77
	23.1	20.4%				75
	24.2	30.0%				71
	25.2	30.0%				72
	26.2	30.0%				74
Olson	27.2	30.0%	17432	6577	45	76
	28.2	30.0%				74
	29.2	30.0%				71
	30.2	30.0%				66
	31.2	30.0%				63
	32.2	30.0%				62
	33.2	30.0%				62
	34.2	50.8%				62

Table 5. continued

Station Name	Distance downstream from headwater (km)	Current Effective Shade (%)	Current Solar Load (ly/day)	Load Allocation		
	35.2	50.7%				59
	36.2	55.9%				61
	37.2	58.0%				62
	38.2	56.0%				60
	39.3	52.3%				54
	40.3	48.0%				53
	41.3	51.1%				52
	42.3	49.7%				51
Mouth	42.9	48.1	12930	12451	2	50

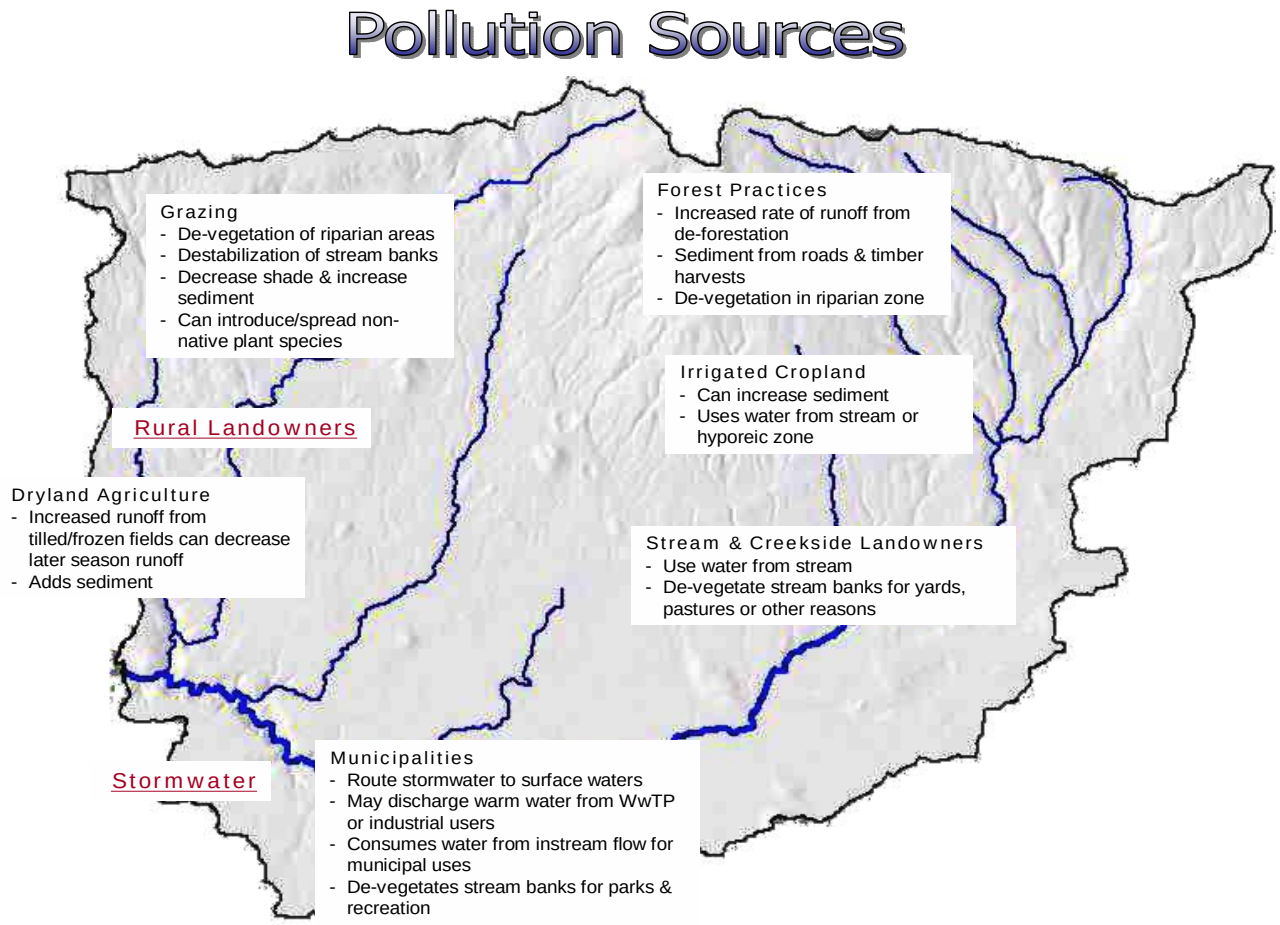

Figure 3: Sources of and causes of water temperature pollution in the Little Klickitat River Watershed (Graphic by Wendy Valdez, Dept. of Ecology)

Flow:

The Little Klickitat River, Bowman Creek, Blockhouse Creek and Bloodgood Creek were 303(d) listed for in stream flows in 1996 and 1998. This TMDL does not set in stream flow targets, but increased water volume in the stream would make increased shading more effective at keeping stream temperatures cool. Water users may want to organize an approach for improving in stream flows, and thus riparian zone conditions, by using an existing planning process such as the 2514 Watershed Planning or the Sub Basin Planning. Additionally, irrigators could evaluate their delivery and application systems to look for ways to irrigate more efficiently, and thus conserve water for in stream uses.

Sediment:

Recruiting sediment that allows soil to develop in the riparian zone and thus provide substrate for riparian vegetation to develop is a valuable stream function that occurs to some extent in all streams. Many factors affect this occurrence in different streams. If stream geomorphology is altered, it can alter this process and thus affect riparian zone health.

Erosion from land disturbances such as farms, timber harvests, road building and others can settle out in streams outside of the normal sediment recruitment process. This causes the width depth ratio of the stream to increase. This means that the stream is shallower and wider than it would be if the sediment were not available from erosion. The result of a larger width and shallower depth is that more sunlight and resulting heat has access to a larger proportion of water. This causes increased stream heating. The technical report identified sedimentation as one reason that width to depth ratios may be increased in the Little Klickitat River Watershed

Near Stream Disturbance Zone Widening:

Widening of the near stream disturbance zone lowers the effectiveness of established riparian vegetation zones because it can locate the stream further from effective shade. The Little Klickitat River Watershed Temperature TMDL technical report also identified the widening of the NSDZ as a potential cause of elevated temperatures. The NSDZ is the zone of disturbance along a stream that is disturbed by flooding and a frequent and forceful enough occasion to disturb the soils so that they only support a limited amount to zero vegetation. The TMDL reported that the NSDZ was larger than what it was expected to be due to recent flood events.

Table 6. Pollution sources with possible explanations, possible causes and possible remedies.

Source	Explanation	Possible Causes	Possible Remedies
Low Streamside Shade	Too few mature trees or brush near thalweg of river allows more solar heating of river water.	Erosion in riparian areas slows growth of new trees, and allows non-native species to displace native plants	Protect riparian area from un-natural disturbances Where possible, make changes upstream to stabilize hydrograph (improve absorption of soils in forested areas; increasing vegetation and changing forest management practices to reduce soil compaction can help here)
		Grazing of cattle along riverbank for long periods may deter growth of new trees, especially in areas where mature trees were removed from the riparian zone for one reason or the other	Control access of livestock to the riparian area via seasonal grazing scheduling
		Historic timber practices and farming practices cleared vegetation out of riparian zone	Follow Forest and Fish Agreement Rules and monitor effectiveness of riparian restoration
			Take advantage of federal and state Programs that promote riparian area conservation
Increased Channel Width:Depth Ratio	River and tributaries wider and shallower than they would be in ideal conditions.	Sediment deposition and movement causes river to be shallower and wider	Reduce sediment erosion from uplands.
	Shallow rivers in summer experience accelerated heating.		Improve maintenance of earthen roads
	Widening of channel causes remaining trees to be farther from shade, thus reducing shade's ability to be effective.		Reduce sediment from overland runoff of logged and grazed areas Reduce sediment from other sources such as construction sites, storm water run-off, and cropland run-off.

Table 6. continued

Source	Explanation	Possible Causes	Possible Remedies
Low summer instream flows	Low flow levels during the hottest time of the year result in more rapid heating of water	Changed hydrograph	Restore watershed features that retain moisture in the upper portions of watershed throughout the year For example: Wetlands and naturally occurring ponds Treed hill slopes with vegetated soil generally retain more moisture than un-vegetated slopes increase absorption by reducing upland soil compaction
		Loss of stream connectivity with hyporheic zone due to channel straightening or sediment input	Increase streams' connection to hyporheic zone:
Bank Stability	Some stream banks in an effort to protect public or private property may be armored with rip-rap or other material	Bank armoring can create bed scour and erosion of other banks by displacing stream energy to areas it should not be	Replace antiquated bank stabilization structures with river/neighbor friendly bank protection methods
			Reduce stream energy by increasing "natural storage" of the watershed such as is suggested under low summer time flow area of table
		Uncontrolled livestock access to streams can de-vegetate and destabilize stream banks	Use BMPs to prevent livestock from damaging stream banks

Responsibilities for Pollution Reduction

Point Sources

The city of Goldendale is responsible for operating its Wastewater Treatment Plant (POTW) in a manner that complies with state and federal law. In this case, they are responsible for following the conditions set in their NPDES permit. Ecology is responsible for writing their permit to follow a compliance schedule that directs the treatment plant to meet the temperature targets set by this TMDL in ten years, or perform All Known and Reasonable Treatment (AKART) for temperature.

Presently, the city of Goldendale has made significant improvements to its publicly owned treatment works that has the potential to improve not only temperature, but also stream flow, DO, and other components of water quality. They completed a re-design and construction of their wastewater treatment plant in 2003. Doing such, they eliminated their use and discharge of chlorine. Another addition to their new system involved installation of a cascading staircase that water falls over on its way to the Little Klickitat River. The cascading staircase raises the dissolved oxygen of the discharge. The upgrades to the city of Goldendale WWTP allow the plant to discharge during the critical period for flow in the Little Klickitat River. This additional flow, albeit, wastewater treatment plant effluent, may help the temperature regime of the main stem Little Klickitat River below the city of discharge.

Nonpoint Sources

Effective Shade:

Realistically, individual landowners hold the responsibility for implementing this portion of the plan. There are programs available for helping the landowners restore the riparian vegetation on their property.

Programs that individual landowners might be eligible to apply for include the Conservation Reserve Enhancement Program, the Continuous Conservation Reserve Program or the Wetlands Reserve Program. In addition, growers should check in with the NRCS and Central Klickitat Conservation District periodically because these organizations sometimes have funds and assistance available for restoration projects that would help implement this TMDL.

The Central Klickitat Conservation District currently has a grant from the Department of Ecology to help with the development, outreach, and implementation of this TMDL. They have been valuable partners on this project, and it is anticipated that they will continue play an important role in the implementation of this TMDL.

Monitoring:
Ecology will hold responsibility to determine if interim and final targets are met. Other monitoring responsibilities may be taken up by other organizations. Currently the Central Klickitat Conservation District monitors sites throughout the Little Klickitat River Watershed.

Management Activities, Roles and Schedules

Activities

As stated previously, actions taken pursuant to this TMDL fall into three categories; voluntary stewardship actions, actions that are taken in accordance with a law or legal agreement and monitoring activities.

Voluntary stewardship activities:

These are the activities that are voluntarily undertaken to help improve overall stream health and help bring stream temperatures during the critical period into the conditions modeled in the technical report:

- Plant native riparian vegetation near streams. Consult with Conservation District Staff or other experts to determine what native riparian zone vegetation is best for your land.
- Fence livestock away from as much of the riparian zone as possible, or use grazing and watering methods that minimize livestock contact with surface and ground water. Consult with Conservation District Staff, NRCS staff or Washington State University Cooperative Extension grazing experts for help with this.
- Locate roads away from the riparian zones.
- Convert irrigation systems to more efficient systems wherever practical
- Allow woody debris to stabilize stream beds and stream banks as possible, practical and as would naturally occur.
- Re-vegetate, and where appropriate re-shape, stream banks.
- Develop farm plans that address temperature as part of their water quality component.
- When possible, use no-till farming practices that reduce runoff rates during rapid snowmelt and rain run off. Not only does this protect cropland soils, but also it allows for a more natural runoff rate and this can keep stream banks stable and minimize flood damage in the NSDZ. (and no-till may increase absorption of water into hyporheic zone)
- Provide off channel water sources for livestock
- Abandon non-essential roads near streams.

Actions that are taken in accordance with a law or legal agreement:

These actions can include but are not limited to:

- For forest managers on private lands, compliance with Forests and Fish rules
- Elimination of illegal water diversions if there are any
- Protection of existing riparian vegetation (especially trees)

- Prevention of entry of sediment into the river, where sediment laden water result from other activities
- Monitoring is discussed in further detail later in the document. Principally, the Department of Ecology, CKCD, and will conduct most of the monitoring related to the TMDL.
- Other entities can provide valuable information to managers of the TMDL if they collect information as part of other technical assessments in the watershed. Information they collect may be valuable to the long term management of the TMDL.

Table 7: Management Roles, Activities and Schedules

Entity	Responsibilities to be met	Year									Beyond 10 Years
		1	2	3	4	5	6	7	8	9	
CMER	Monitoring of Forests and Fish rules in support of adaptive management	X	X	X	X	X	X	X	X	X	X
DNR	Administration and enforcement of Forests and Fish rules	X	X	X	X	X	X	X	X	X	X
Homeowners with waterfront property	Avoid actions that will cause stream bank destabilization or erosion, or will otherwise add sediment to area waterways or decrease shading of the riparian area	X	X	X	X	X	X	X	X	X	X
Irrigators and Irrigation Entities (Districts and Companies)	Implement BMPs to conserve water and provide in stream flow	X	X	X	X	X	X	X	X	X	X
CKCD, NRCS and Ecology	Continue to fund agricultural BMP implementation:	X	X	X	X	X	X	X	X	X	X
CKCD, NRCS	Extend outreach efforts and technical assistance to all agricultural producers (irrigators, livestock managers, others) in the watershed	X	X	X	X	X	X	X	X	X	X
Central Klickitat CD	Continue to monitor water quality of the watershed's surface waters	X	X	X	X	X	X	X	X	X	X
Klickitat County	Administration of Critical Area Ordinances and Shoreline Master Programs	X	X	X	X	X	X	X	X	X	X
Private and state timber owners	Implement forest management practices as required by Forests and Fish rules	X	X	X	X	X	X	X	X	X	X
Ranchers	Implement livestock management BMPs to prevent stream bank de-vegetation and erosion	X	X	X	X	X	X	X	X	X	X

Measuring Progress Toward Goals

As noted earlier, the implementation goal of this project is to decrease stream temperatures in the Little Klickitat River Watershed by increasing riparian vegetation's contribution to effective shade. Cooling of stream water may also be accomplished by increasing summer instream flows. Progress toward many of the TMDL goals can be measured using the milestones in Table 7.

Different implementation schedules will be used for different types of activities. Actions that are taken in accordance with a law or legal agreement will be completed within the timeframe prescribed in the law or legal agreement. Riparian stewardship actions will be completed along with monitoring for temperature (water and air). Annual collection of data is ideal for establishing long term baselines, but at a minimum, effectiveness monitoring should be conducted every five years. Detailed effectiveness monitoring should be collected every ten years.

Ecology is the entity ultimately responsible for determining compliance with targets. Ecology will meet with the Central Klickitat Conservation District and other involved organizations (such as the city of Goldendale and Klickitat County) annually to review current monitoring data and discuss project progress toward targets until goals are met. If this workgroup, as it is, believes progress towards goals is inadequate, then adaptive management may be considered and initiated.

Table 8: Milestones for the Little Klickitat River Watershed Temperature TMDL

Action No.	Description	Measurement Method	Goal	When Monitored
1	Education			
	a. Educational events	Number of education activities and area covered	Educational activities each year	Annually
	b. Create, publish and distribute educational publications regarding river protection and restoration	Amount of material distributed	Twice a year	Annually
2	Riparian Vegetation			
	a. Plant new vegetation along stream banks	Total number of plants and miles of riparian zone planted	Plant as much native riparian vegetation as possible	Ongoing
	b. Protect riparian vegetation plantings	Percentage plants that survived	% plant survival first and fifth years	Ongoing
	c. Increased Stream Shading	measure compared to baseline established in the technical report	increased number each time assessed	every 10 years, or as data available
3	Reduced Stream Temperature			
		Compare Stream Temperature to baseline	Data shows reduction in stream temperature	at least every 5 to 10 years

Effectiveness Monitoring Plan

Effectiveness monitoring evaluates whether the management activities achieved the desired effect or goal. Success may be measured against controls of baseline conditions, or desired future conditions. This type of monitoring addresses the effectiveness of a particular project against standards or a desired outcome. For example, did trees planted along the margin of the stream produce effective shading for reduction of water temperature? This type of monitoring is designed to assess both the specific effects of individual management actions and the overall cumulative effect of nonpoint source management programs statewide.

Monitoring is a valuable part of the implementation strategy. It serves to track and evaluate the effectiveness of implementation measures. Four general monitoring procedures were recommended in the Summary Implementation Strategy. These monitoring procedures are recommended to continue in the Little Klickitat River Watershed.

Procedure 1: Track Stream Temperature

Stream temperature should be monitored for attainment of standards and the results evaluated at five year intervals and as consistent with timelines established in the F&F Rules. Ideally, temperature monitoring with in stream thermistors and data loggers should occur each summer during the critical period.

Temperature monitoring results should be compared to previous years' monitoring results, state water quality standards, the predicted temperatures under natural conditions presented in the technical report, and to the results of monitoring as described by number 2 below.

As mentioned in the SIS, the relationship between stream temperature and air temperature will be used to track progress. The regression of water temperature against air temperature will be plotted over time to determine whether stream temperatures are cooler for specific air temperatures. If stream temperature does not decrease relative to the air temperature, a reassessment of modeling parameters and/or adaptive management may be needed. This approach may used with any of the parameters listed below as well; however, due to the additive affects of all of the parameters below, a correlation with just one of them, (excepting shade) is not likely to be easily seen.

Procedure 2: Monitor Physical Parameters Known to Affect Stream Temperatures

Parameters that may be monitored include shade, active channel zone widths, width to depth ratio, sediment (bedload, suspended sediment, turbidity), air temperature, and flow. Baselines of these parameters should be established and surveys conducted in at least five to ten-year intervals. Aerial photos may be used to determine completeness over all reaches of concern.

Keep track of natural events that might influence stream temperature over time. Range and forest fires definitely affect stream temperatures. Floods can change the channel of the river. All of these things should be tracked. Weather records are kept by the national weather service and can be used as guides for evaluating temperature conditions in the watershed.

Procedure 3: Track Implementation

Implementation of riparian restoration activities and instream flow restoration should be tracked, as well as implementation of existing regulations.

The Conservation District should keep track of projects in the Little Klickitat River Watershed that could result in improved temperature conditions in the Little Klickitat River Watershed. Additionally, Ecology should keep track of projects related to point sources, storm water, and stream flow improvements.

Individual projects should be tracked and monitored for their effectiveness establishing shade, bank stabilization, water conservation and other things. In the end, watershed recovery depends on the completion of several finished and sustainable projects.

Another parameter that is important to track as part of implementation tracking is cost. The cost of watershed restoration projects to landowners, local, state and federal government agencies is worth tracking. The information could be used to evaluate the estimated cost for future water quality protection costs in the watershed, or it could be used by planners in other watersheds.

Procedure 4: Track Temperature-Dependent Biota and Other Parameters as Appropriate

The health of macroinvertebrate and salmonid populations and/or other indicators may be used to track recovery of the riparian and river systems. The presence of a healthy aquatic ecosystem typical of this type of stream will be a useful indicator of success of this project.

Ecology's Environmental Assessment Program established an ambient biological monitoring station on the Little Klickitat River near Highway 97. More information about Ecology's Ambient monitoring of macro invertebrates can be found at:

http://www.ecy.wa.gov/programs/eap/fw_benth/ambient.html

Adaptive Management

If planned implementation activities are not producing expected results, Ecology or other entities may choose or be mandated to perform additional studies to identify the significant sources of heat input to the river system. If the causes can be determined and the remedies are required by law or legal agreement, then additional implementation measures may be needed. If the causes cannot be determined or if the causes are found to be naturally occurring, then the TMDL targets may need to be revised. For non-federal forested areas, the agreements in the Forests and Fish Report incorporate adaptive management as needed to meet the allocations in this report. Re-evaluation of this TMDL is anticipated to occur at five to ten-year intervals. If progress toward cooler water temperatures cannot be detected, then the TMDL may be modified as a result.

As mentioned in the monitoring section, natural occurrences of fire and flood can affect hydrology and riparian vegetation. Keeping track of these occurrences is important for assessing the effectiveness of implementation and for setting schedules.

Reasonable Assurances

Current Implementation Efforts

As noted in the Summary Implementation Plan, Ecology believes that the following activities are already supporting this TMDL and add to the assurance that surface water temperatures in the Little Klickitat River Watershed will meet conditions provided by state water quality standards. This assumes that the below described activities are continued and maintained.

- Past and ongoing activities by the CKCD, city of Goldendale, Washington State Department of Fish and Wildlife, NRCS, Ecology, Yakama Nation Fisheries Program, and landowners already support the goals of this TMDL.
- The NRCS promotes and administers the Conservation Reserve Enhancement Program (CREP) and the Continuous Conservation Reserve Program (CCRP). These programs are available to landowners as incentive to protect and enhance riparian zones.
- In 2001, the Department of Ecology granted the Central Klickitat Conservation District a Centennial Clean Water Fund Grant to assist with development, outreach and implementation of this TMDL. They have already conducted valuable monitoring, outreach activities, and sponsored two projects with funds from this grant.

Not mentioned in the TMDL Submittal report was the city of Goldendale's change of diversion of 1.4 - 2.0 cfs from Bloodgood Springs to their Simcoe Mountain Springs. This will leave 1.4-2.0 cfs in Bloodgood Springs depending on the time of the year, and instead take water from a deeper well. This improved flow, and other projects like it, have the potential to improve temperatures throughout the Little Klickitat River Watershed.

The city of Goldendale has made various contributions to early implementation of this TMDL, and shows interest in continuing to make improvements that could help water quality in the Little Klickitat River Watershed. For example, the city took on the expense to cover its Waste Water Treatment Plant's clarifiers, installed a cascading staircase that aerates its discharge prior to

entering the Little Klickitat River. Also, in the past the city of Goldendale has installed bank stabilization jetties, planted streamside vegetation and installed bio-swales in the city's industrial park. Additionally, the Cal-Pine Energy Plant installed chillers to treat its effluent that flows to the WWTP.

Timber harvesting activities by state and private forest landowners are conducted according to the Forest Practices Rules and the Forest and Fish (F&F) Agreement, which includes provisions for monitoring rule effectiveness and for adaptive management of the rules. Although it is anticipated these rules will result in greater protection of water quality than afforded by previous timber harvesting regulations, there is not yet any information available with which F&F can be evaluated. Long-term monitoring of this TMDL will provide information needed to direct future management of the Forests and Fish Agreement implementation in the Little Klickitat River Watershed as it related to water quality protection.

Ecology's NPDES program is working with the city of Goldendale's Wastewater Treatment Plan to develop a compliance schedule for this TMDL.

Since the publication of the Little Klickitat River Watershed Temperature TMDL submittal report, two more planning processes have grown in Klickitat County that may help the Little Klickitat River. The Water Resource Inventory Area 30 Planning Unit has completed an assessment of water quality problems in the Little Klickitat Watershed. Additionally, the sub-basin plan for the Klickitat and Horseheaven watersheds.

Supporting Regulations, Legal Agreements and Enforcement

Several laws, regulations, legal agreements and land management plans support the efforts of this DIP by guiding riparian area activities on lands under a variety of property ownership. These include Forest and Fish Rules (covers activities on private and state-owned forested lands); county ordinances; the Shorelines Management Act (covers shorelands within 200 feet of rivers, on non-federal lands); the Washington Water Code (covers water use throughout the basin); and Washington State water quality laws and regulations (covers water quality in all water bodies in the basin). Washington's Water Pollution Control Act (Chapter 90.48 RCW) provides broad authority to issue permits and regulations, and prohibits all discharges of pollutants to water. The act declares that it is the policy of the state to maintain the highest possible standards to ensure the purity of all waters of the state and to require the use of all known, available, and reasonable means to prevent and control water pollution. The act defines waters of the state and pollution, and it authorizes the Department of Ecology to control and prevent pollution, to make and enforce rules, including water quality standards. Compliance with existing laws and legal agreements will preclude enforcement or other legal action by appropriate organizations. Where compliance is not forthcoming, then education, outreach, technical and financial assistance, and procedures described by a Memorandum of Agreement between the Washington State Department of Ecology and Central Klickitat Conservation District will be used to the maximum extent prior to initiating any enforcement actions.

Public Involvement

Throughout the TMDL development, the public had various opportunities to comment and to involve themselves in the development of the quality assurance project plan (QAPP), the Technical Report, and the TMDL Submittal Report. The public will have an opportunity to comment on this DIP before it is published.

During the entire TMDL implementation period, monitoring data and status reports will be available for public review and comments. Periodic updates will be provided to area media and other interested parties.

Funding Opportunities

Inevitably, watershed protection results in costs to landowners in the watershed. There are numerous existing and potential funding sources in the Little Klickitat River Watershed that can ease this burden, including:

- The Natural Resources Conservation Service often provides cost-share funding to agricultural producers for farm plan implementation and conservation improvements on farms via its Environmental Quality Incentives Program (EQIP) and their Conservation Reserve Enhancement Program (CREP); additionally, the EQIP program can now fund forest road improvements, giving priority to fish passage improvements.
- The Central Klickitat Conservation District provides cost-share funding for agricultural improvements.
- Ecology funds water quality facilities and activities through its water quality grants program.

Currently, the Central Klickitat Conservation District is funding staff and project needs related to this TMDL with a Centennial Clean Water Fund grant. Since the start of the TMDL they have completed projects that protect riparian areas in the Little Klickitat Watershed with Shoreline Protection Account Grants and money from the Centennial Clean Water Fund. NRCS has used CCRP and EQIP to protect riparian zones in the watershed. Also, for many of these projects, labor was provided by the Washington Conservation Corps and the Northwest Service Academy. Additionally the city of Goldendale utilized State Revolving Loan Funds to finance its most recent upgrade of the Wastewater Treatment Plant.

Potential funding sources include resources offered through the Centennial Clean Water Fund and the state 319 grants and loan program. Additionally, there are other sources of funding available for salmon habitat, salmon restoration efforts and associated projects that support actions that could increase riparian shade and instream flows.

Potentially, the above funding resources could be utilized by the city of Goldendale to implement improvements in their WWTP as the compliance schedule progresses. Any NPDES permitted point sources discharging effluent to the WWTP are also eligible for State Revolving Fund (SRF) loans to make capital improvements that improve water quality.

Also, regarding the SRF loan program, in recent years eligible organizations have applied for and utilized SRF funding to fund capitol improvements (such as upgraded irrigation systems) to protect water quality from non point source pollution. This may be a possibility for the completion of some projects in some cases.

The Conservation District has applied for other funding support for projects in the Little Klickitat River Watershed. There is a variety of project funding sources available, the Environmental Finance Center at Boise State University Sponsors an internet web site that inventories funding sources. It can be found at http://sspa.boisestate.edu/efc.

Appendix A:
List of Acronyms

List of Acronyms

303(d) list - List of water bodies that do not meet Washington State water quality standards

BMP - Best Management Practices

CFS - Cubic feet per second

CKCD - Central Klickitat Conservation District

CMER - Cooperative Monitoring Evaluation and Research Committee

DIP - Detailed Implementation Plan

DNR - Department of Natural Resources

EPA - Environmental Protection Agency

MOA - Memorandum of Agreement

RCW - Revised Code of Washington

NRCS - Natural Resource Conservation Service

NSDZ - Near stream disturbance zone

SIS - Summary Implementation Strategy

SRF - State Revolving Fund

TMDL - Total Maximum Daily Load

WLA - Waste Load Allocation

WWTP - Waste Water Treatment Plant

Appendix B:
Conversion Table

Conversion Table
Between degrees C (Celsius) and degrees F (Fahrenheit)

Degrees C	Degrees F
0	**32**
5	**41**
10	**50**
12	**53.6**
15	**59**
17	**62.6**
19	**66.2**
21	**69.8**
23	**73.4**
25	**77**
27	**80.6**
29	**84.2**
30	**86**